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Taxonomic Notes on the Lichen Family Verrucariaceae in Japan (IX). *Verrucaria rheitrophila* Zsch., New to Japan

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The lichen species *Verrucaria rheitrophila* Zsch. (Ascomycota, Verrucariaceae) is reported as new to Japan. It was found on inundated rocks in upper stream of rivers in western Honshu. Description and figures are provided on the basis of the Japanese specimens. The lectotype is selected.

Lichen species growing on riverside or lakeshore rocks are known as freshwater or aquatic lichens. In Europe there have been known many freshwater species of *Verrucaria*, for example, nine species in the British Isles (Purvis et al. 1992), twenty four in western Europe (Clauzade and Roux 1985), twelve in Sweden and Norway (Santesson 1993). In Japan, on the other hand, this group of lichens has not been sufficiently studied, with records for only two species, *V. nipponica* Zahlbr. (Zahlbruckner 1916, Harada 1992) and *V. aquatilis* (Yoshimura 1963). As a part of my taxonomic works on the Verrucariaceae, I have made field trips for surveying little-known aquatic *Verrucaria* in this country, and collected species differing from these two species. Among them, *V. rheitrophila* Zsch. is reported here as the third species. A description, figures and remarks for this species are provided on the basis of the specimens from Japan.

Material and Methods

Specimens from Japan used in the present study are preserved in the herbarium of Natural History Museum and Institute, Chiba (CBM). Specimens including type from the two herbaria (B and W) were also examined.

Air-dried material was examined for describing external morphology with the naked eyes or under a dissecting stereoscope unless otherwise stated. For anatomical observation, sections were made with the aid of a razor blade under the dissecting stereoscope. Lactophenol cotton-blue (abbreviated as LPCB) preparations were used for describing anatomy except for descriptions of color which were taken from GAW (glycerol : ethanol : water = 1 : 1 : 1) preparations. Line drawings were taken from the LPCB or GAW preparations.

Taxonomy

Verrucaria rheitrophila Zsch., Verh. Bot. Ver. Prov. Brandenburg **64**: 108 (1922), as "*Verrucaria rheithrophila*". Type: In einem Bächlein unter dem Meiseberge, Nordost-Harzes (B-86741 – lectotype selected here).

Verrucaria kernstockii Zsch., Hedwigia **67**: 65 (1927). Type: Exs.: Arn. 1566 (two specimens in W – syntypes); Flora exsicc. Austro-hung. 2772 (Brmn.)

as *V. aquatilis* (two specimens in W – syntypes).

External morphology: Thallus epilithic, continuous, ± with inconspicuous cracks in herbarium, somewhat pale to very dark brown or almost black, dull, smooth to rough (due to carbonized particles), with black dots (ca. 0.01 mm across, sparse to very dense), non-pruinose, gelatinized when wet; margin not lobed, abruptly ending or gradually becoming thinner, with sparser and smaller black dots. Perithecia simple, scattered over the thallus, half to almost completely immersed in the thallus, almost black near the top, when elevated 0.2–0.3 mm across, almost round at the apices, with an ostiole at the top, depressed around the ostioles. Pycnidia not seen.

Anatomy: Thallus 20–200 μm thick, lacking epinecral layer; cortex undifferentiated; medulla (including algal layer) more or less brown in the uppermost ca. 5 μm, hyaline in the remainder, continuous or interrupted by carbonized or brown tissue, sub- to eu-paraplectenchymatous, lumina of hyphae 2–6 μm high × 1–3 μm wide, more or less in vertical rows, walls of hyphae ca. 1 μm thick; phycobiont cells almost evenly distributed throughout medulla, solitary or in small clusters; the carbonized particles in various density, at various height, sometimes forming vertical columns, usually more dense around the side of perithecia. Perithecia (excl. involucrellum) almost spheric, 130–230 μm high × 120–190 μm wide; involucrellum lacking a distinct structure, prominent (ca. 50 μm thick) or improminent around the upper

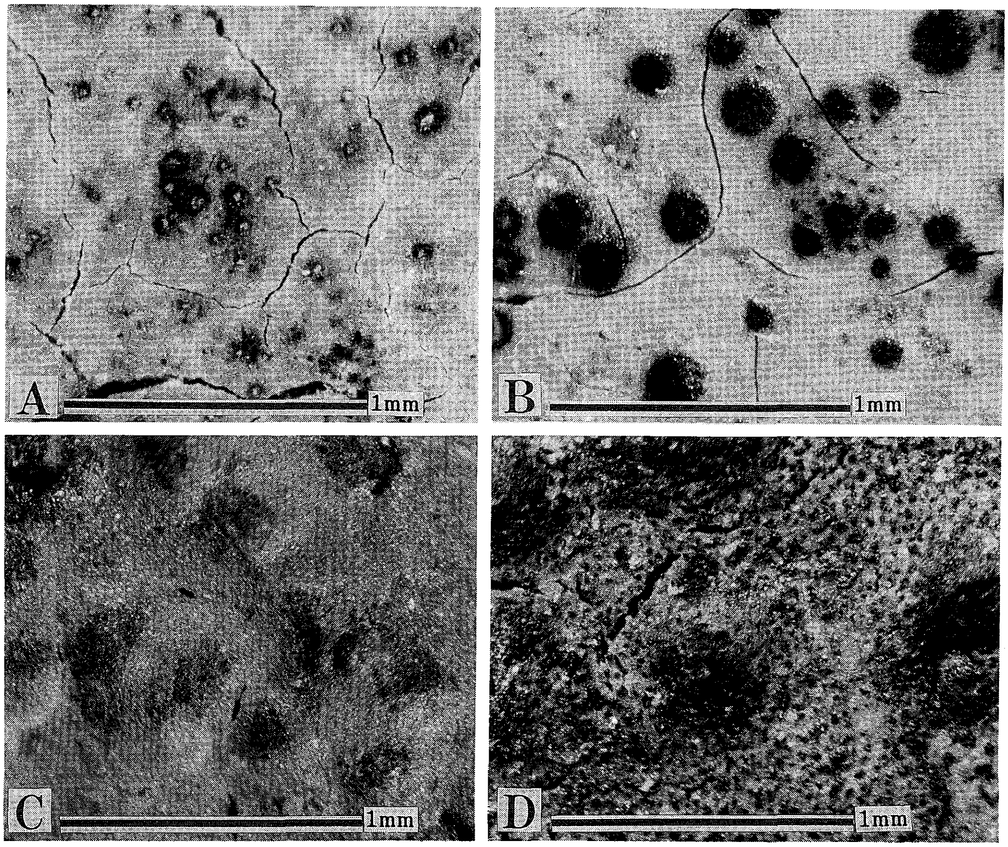

Fig. 1. Habit of *Verrucaria rheitrophila*. A: Lectotype of *V. rheitrophila*. B: Holotype of *V. kernstockii*. C, D: *V. rheitrophila* from Japan (Harada 14149).

part of perithecium, ± partly composed of carbonized particles in the distal parts, carbonized or very dark brown to almost black; exciple hyaline or brownish, but usually brown to black in the upper part, 10–15 μm thick in the sides and at the bottom; subhymenium concave above, 10–25 μm thick in the center; periphyses almost simple, ca. 15 μm long; hymenium 130–180 μm high × 120–140 μm wide; asci clavate, ca. 25 μm long × 10–15 μm wide; spores 8 in each ascus, hyaline, simple, ellipsoidal (to oval), 9–14 × 5–7 μm.

Habitat: On frequently or usually inundated rocks in the upper stream of rivers with clear water through forests in the cool-temperate zone. ± Associated with *Staurothele iwatsukii* Harada, *Endocarpon japonicum* Harada, and/or *Dermatocarpon miniatum* (L.) Mann.

Distribution: Japan (western Honshu), Europe, North America.

Specimens examined: JAPAN. Honshu. Okayama-ken, Tomata-gun, Okutsu-chô, Okutsu, 450 m alt., Harada 14218 (CBM); Atetsu-gun, Oosa-chô, in the vicinity of Oosa Dam, 450 m alt., Harada 14147, 14149, 14150 (CBM). Hiroshima-ken, Yoshiwa-mura, Mt. Kanmuri, 850–900 m alt., Harada 2670 (CBM, HIRO).

EUROPE. FRANCE. L'Hermitain de la Moth Saint-Heray, Arn. Exs. 1190 (W-9441); Lojka Lichenoth. Univ. 245 (W); 24 Sept. 1886, J. Richard (W-2925).

Among freshwater species of this genus in Japan, *Verrucaria rheitrophila* Zsch. is easily distinguished by having carbonized particles in the thallus, and small spores (9–14 × 5–7 μm).

A great variation in the density of carbonized particles appearing on the thallus surface as well as in the thallus section was found in the specimens from Japan (Fig. 1), as already known for the European

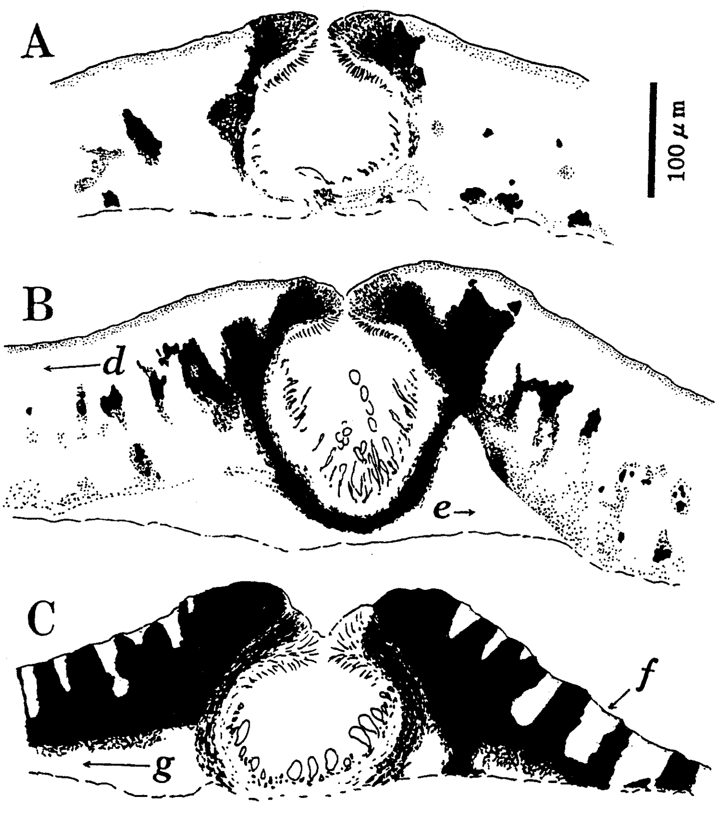

Fig. 2. Vertical sections of perithecia. A, B: Harada 14149. C: Harada 2670. (A–C, GAW preparations).

population (Swinscow 1968). The particles are distributed at various depth within the thallus (Fig. 2) in variable densities, and, in some cases, form vertical columns (Fig. 2C). It gives a great diversity to the carbonized tissue around the perithecia. In Fig. 2A, the perithecium has the blackened exciple in the upper part and almost completely lacks involucrellum just like Purvis et al. (1992) described as "poorly developed and represented only by a thickened upper exciple". In Fig. 2B, carbonized particles are developed rather intensely around the upper part of the exciple so that the "involucrellum" is formed. The involucrellum may spread laterally to almost the base level of the perithecium (Fig. 2C). As shown in these figures, a distinction can hardly be made between the involucrellum and the carbonized particles, so that the description of the involucrellum in this species as "not developed as a distinct structure" (Swinscow 1968) seems to be more appropriate.

The thallus in the Japanese specimens is, when fresh and wet, somewhat pale to dark greenish brown or brownish green (except for almost black thalli which are due to the very dense carbonized particles or ridges on the surface), and tends to be darker than the European population which has green to grayish-green thalli (Swinscow 1968, Purvis et al. 1992). The difference is perhaps due to the ecological difference such as the influence of the sunlight or the frequency of exposure outside water, and has no taxonomic value.

Two specimens were available for this study from Berlin (B) on my request of the type specimen of *Verrucaria rheitrophila* Zsch. (Fig. 4). One of the specimen (B-86740) contains a piece of rock which is covered mostly by a Rhodophyta, *Hildenbrandia* (?), and only a small thallus (less than 5 × 5 mm) of

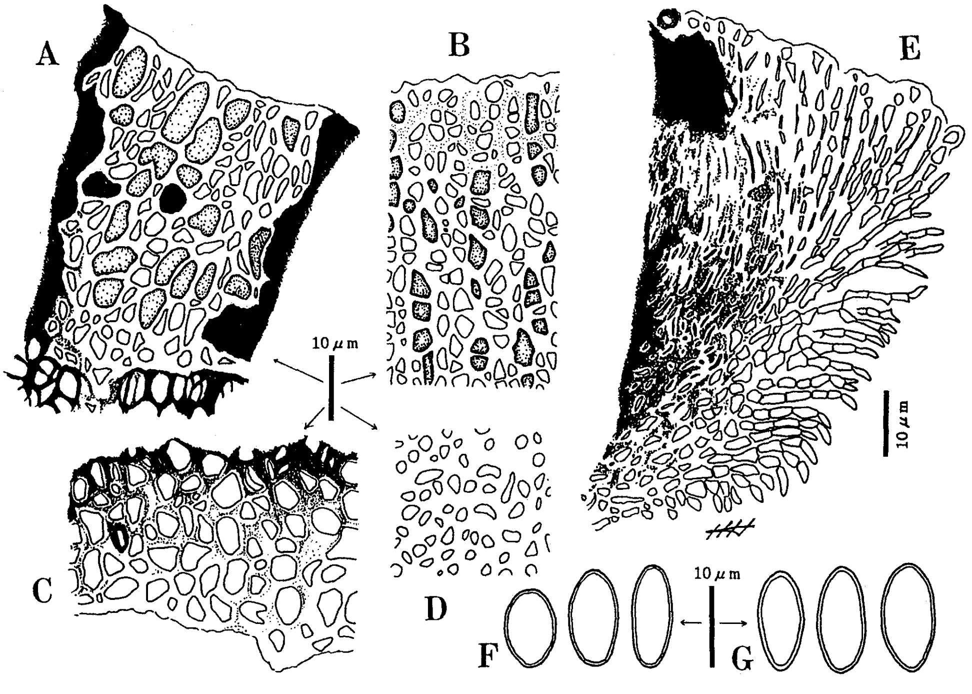

Fig. 3. Anatomy of *Verrucaria rheitrophila*. A–D: Part of vertical section of thallus (A, at f in Fig. 2C; B, at d in Fig. 2B; C, at g in Fig. 2C; D, at e in Fig. 2B). E: Part of vertical section of perithecium. F, G: Spores. (A, C, E, F, Harada 2670; B, D, G, Harada 14149. A–G, LPCB preparations).

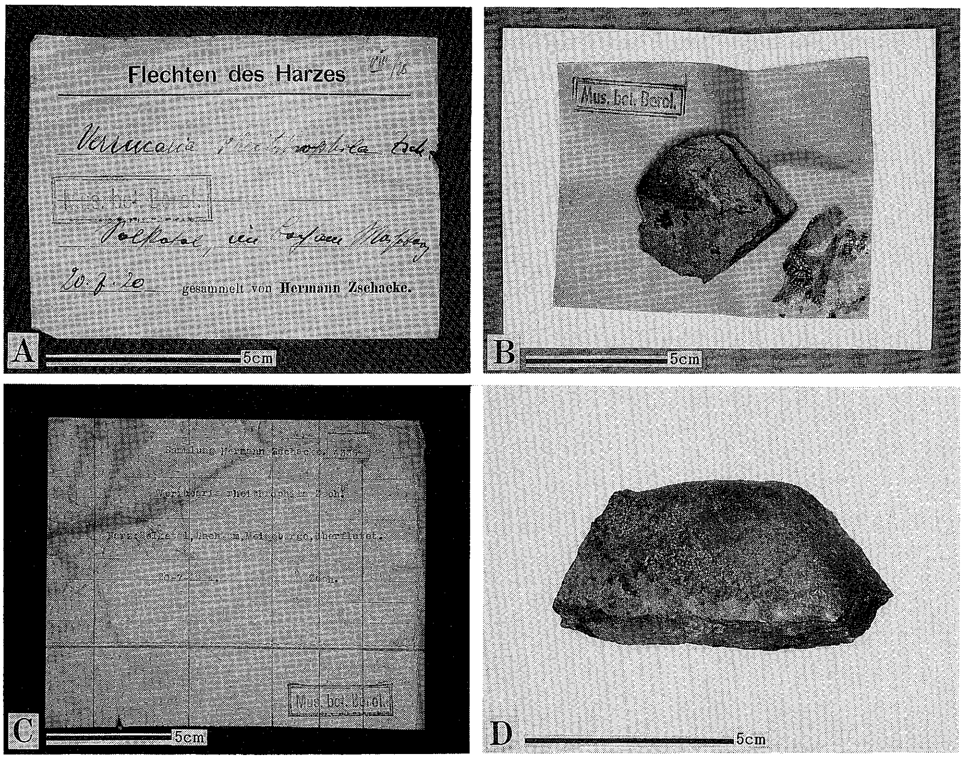

Fig. 4. Type specimens of *V. rheitrophila*. A, B: Lectotype (B-86741). A: Label inside the packet. B: Specimen). C, D: Syntype (B-86740). C: Label inside the packet. D: A piece of rock glued on card.

Verrucaria is found. The packet contains a card (Fig. 4C) on which were typewritten species name, collection locality (as "Harz: Selketal, Bach am, Meiseberge, überflutet"), its date (as "20-7-1914"), etc. At the lower right, letters in three lines by pencil are seen as "hymenium", "K+ rot", and "braun". In the other specimen (B-86741), a piece of rock is mostly covered by the same *Verrucaria* species as the former specimen. On the original label inside the packet (Fig. 4A), "Flechten des Harzes" on the top and "gesammelt von Hermann Zschacke" at the bottom is printed. Letters written in blue-black ink read "*Verrucaria rheitrophila* Zsch.", "Selketal, im Bach am Meiseberg", and "20.7.20". The morphology of the lichen of these specimens does not conflict with the protologue of *V. rheitrophila* (Zschacke 1922). In consideration of the morphology and label data, these specimens are regarded as syntypes. The latter specimen (B-86741) is selected here as the lectotype because of richness of the material.

I acknowledge loans of specimens from the following herbaria: Botanischer Garten und Botanisches Museum Berlin-Dahlem (B), and Naturhistorisches Museum Wien (W). I thank Dr. C. Keller, University of Berne, for critically reading the manuscript and Prof. T. L. Esslinger, North Dakota State University, for correcting the English text.

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原田　浩: **日本産アナイボゴケ科地衣類分類ノート(IX). 日本新産の *Verrucaria rheitrophila* Zsch.**

アナイボゴケ属 ***Verrucaria*** 地衣類には河川や湖沼の水没する岩に生える淡水生（freshwater あるいは aquatic）の種類が多数知られているが，日本ではこれまでに ***V. nipponica*** Zahlbr. と ***V. aquatilis*** Ach. が知られるのみであった（Harada 1993, Yoshimura 1963）. 著者の最近の研究により，第3の種 ***Verrucaria rheitrophila*** Zsch. の生育を確認したので報告する．

本種の地衣体は淡褐色から暗褐色で，黒い微小な点を散在あるいは密生することで淡水生の種の中では際だっている．また，胞子が小さいことも特徴である．本種はこれまでヨーロッパと北米に知られているが，日本だけでなくアジアでも従来は記録がなく，今回が最初となる．

産地は岡山県と広島県の山間部である．いずれの場合も渓谷の転石や根岩の水際に生えていた．調査した94年の夏は酷暑により水量が少なかったため通常では水没するような箇所に生育していたと思われる．水位との関係では，既に知られている淡水生のヤマトアナイボゴケに比べてやや低い位置を占める傾向があるようである．

（千葉県立中央博物館）